Mine is better than yours: Investigating the ownership effect in children with autism spectrum disorder and typically developing children.

Word count: 9480 (excluding figures & references)

Abstract

Ownership has a unique and privileged influence on human psychology. Typically developing (TD) children judge *their* objects to be more desirable and valuable than similar objects belonging to others. This 'ownership effect' is due to processing one's property in relation to 'the self'. Here we explore whether children with autism spectrum disorder (ASD) – a population with impaired self-understanding – prefer and over-value property due to ownership. In Experiment 1, we discovered that children with ASD did not favour a randomly endowed toy and frequently traded for a different object. By contrast, TD children showed a clear preference for their randomly endowed toy and traded infrequently. Both populations also demonstrated highly-accurate tracking of owner-object relationships. Experiment 2 showed that both TD children and children with ASD over-value their toys if they are self-selected and different from other-owned toys. Unlike TD children, children with ASD did not over-value their toys in comparison to non-owned identical copies. This finding was replicated in Experiment 3, which also established that mere ownership elicited over-valuation of randomly endowed property in TD children. However, children with ASD did not consistently regard their randomly endowed toys as the most valuable, and evaluated property irrespective of ownership. Our findings show that mere ownership increases preferences and valuations for self-owned property in TD children, but not children with ASD. We propose that deficits in self-understanding may diminish ownership effects in ASD, eliciting a more economically-rational strategy that prioritises material qualities (e.g. what a toy *is*) rather than whom it belongs to.

Keywords:

Autism spectrum disorder; Ownership; Ownership effect; Self-understanding; Valuation; Typical development.

Mine is better than yours: Investigating the ownership effect in children with autism spectrum disorder and typically developing children.

1. Introduction

Ownership is a vital cornerstone of human culture (Brown, 1991). Determining 'who owns what' is fundamental to myriad social behaviours, ranging from playground disputes to international political decisions (Bloom & Gelman, 2008; Gelman, Manczak, & Noles, 2012; Kalish & Anderson, 2011). Ownership also has a unique and privileged influence on human psychology. We feel deeply connected to our possessions, and there is an undeniable relationship between the property we own and our sense of identity (Belk, 1985, 1991, 2000; Diesendruck & Perez, 2015; James, 1890; Rochat, 2010). Across disciplines, it is argued that property is psychologically influential because establishing ownership causes items to be processed in relation to the 'psychological self' (Belk, 1988; Csikzentimihalyi & Rochberg-Halton, 1981; Diesendruck & Perez, 2015; Hood, Weltzien, Marsh, & Kanngiesser, 2016; Satre, 1956). Thus, ownership understanding may be atypical when the psychological self is impaired. The purpose of the present study is to investigate how Autism Spectrum Disorder (ASD) – a neurodevelopmental disorder characterised by an impaired psychological sense of self (Frith, 2003; Grisdale, Lind, Eacott, & Williams, 2014; Lind, 2010; Williams, 2010; Uddin, 2011) – impacts the cognitive bias towards self-owned property and evaluations of property owned by others.

Owing to its cultural and psychological salience, ownership understanding normally emerges in early childhood. By 2 years, typically developing (TD) children refer to objects using possessive pronouns (e.g. "mine", "yours") and are able to infer owner-object relationships independent of physical possession (Fasig, 2000; Friedman, Van de Vondervoort, Defeyter, & Neary, 2013; Saylor, Ganea, & Vázquez, 2010). By 3-4 years, ownership can be inferred based on a range of heuristics including verbal testimony, first possession, stereotypes, and historical reasoning (Nancekivell, Van de Vondervoort, & Friedman, 2013). Coinciding with this developing knowledge, TD toddlers frequently engage in heated disputes over property access (Hay & Ross, 1982) and subjectively evaluate objects based on historical connections to themselves or other people. In particular, TD children show a 'mere ownership effect' – increased valuation and preference for objects simply

because they are owned – by 2-5 years (Gelman et al., 2012; Hood & Bloom, 2008; Hood et al., 2016; Harbaugh, Krause, & Vesterlund, 2001).

It is widely agreed that TD children form strong emotional attachments to their property (Winnicott, 1969). Hood and Bloom (2008) found that TD children aged 3 to 6 years were reluctant to let an experimenter "make" an identical copy of a cherished possession, and almost all preferred their authentic objects over replicas. When asked why they preferred the authentic object over the copy, they frequently responded "because it's mine". Other studies show that TD children form attachments to property after only brief periods of ownership. Employing a classic resource exchange paradigm, Harbaugh, Krause and Vesterlund (2001) gave participants aged 5, 10 and 20 years a gift to keep, and then asked if they wished to trade it for an alternative of similar value. Across different pairs of goods, participants were 1.9 to 2.9 times more likely to keep the item they were initially assigned and this effect did not differ with age. Thus, the preference for self-owned property develops in early childhood and endures into adulthood (for replications of this phenomenon, see Beggan, 1992; Gawronski, Bodenhausen, & Becker, 2007; Kahneman, Knetsch, & Thaler, 1990; Knetsch, 1989; Reb & Connoly, 2007; Thaler, 1980). Gelman and colleagues (2012) recently found that simply stipulating an ownership relation is sufficient to elicit a preference for novel objects in children as young as 2 years. Remarkably, a reliable preference for self-owned objects was observed even when those objects were relatively unappealing or identical to comparison objects (also see Hood et al., 2016). Taken together, these findings unambiguously demonstrate that ownership "… confers special value, above and beyond an object's material or functional properties" (Gelman et al., 2012, p. 1733).

The cognitive bias for one's own property is attributed to our regarding of objects as *extensions of the self* (Belk, 2000; Csikszentimihalyi & Rochberg-Halton, 1981; Diesendruck & Perez, 2015; Morewedge & Giblin, 2015; Sartre, 1956; Winnicott, 1953). The 'extended-self hypothesis' posits that an individual's self-concept incorporates property items – both material (e.g. cherished possessions) and immaterial (e.g. hobbies and interests) – that represent their personal identity (Belk, 1988; Dittmar, 1992; James, 1890). At a psychological level, ownership constitutes an autobiographical attachment between an object and the self that is maintained over time. Once this attachment is forged, the object may be integrated into a person's extended self-concept and, in turn,

an abstract trace of the self may transfer to the object through '*contamination*' (Argo, Dahl, & Morales, 2008). This mentalistic connection to property explains why self-owned possessions are more memorable, desirable, and judged to be more valuable than similar non-owned items (Cunningham, Vergunst, Macrae, & Turk, 2013; Gelman et al., 2012; Gelman, Frazier, Noles, Manczak, & Stilwell, 2015; Kahneman, Knetsch, & Thaler, 1991). From a developmental perspective, children's concept of ownership is thought to arise from extending their sense of self to objects (Humphrey, 1992; Rochat, 2010). Indeed, Diesendruck and Perez (2015) recently demonstrated that TD children treat owned objects as extensions of the self by 5 years.

Knowing that you *own* an object is contingent on forming and retaining an invisible, socially meaningful, association with the self. This knowledge demands an awareness of the self as continuous in time (in conjunction with the object) *and* an understanding of ownership as a social construct (Fasig, 2000). However, many children with ASD experience impaired awareness of the psychological self (Frith, 2003; Lind, 2010). It is well-documented that individuals with ASD have difficulty using first person pronouns (e.g "I" and "me"; Jordan, 1996; Lee, Hobson, & Chiat, 1994; Lind & Bowler, 2009), and have diminished awareness of their emotions and mental states (e.g. Ben Shalom et al., 2006; Hill, Berthoz & Frith, 2004; Silani et al., 2008; Williams & Happé, 2010). These children also show impaired memory for personally experienced events and impoverished knowledge of personal facts (e.g. Bruck, London, Landa, & Goodman, 2007; Goddard, Howlin, Dritschel, & Patel, 2007). These findings indicate that the self does not provide a robust organising structure within the memory of children with ASD, reducing their ability tag information as self-relevant and inhibiting their development of an extended self-concept (Lind, 2010). These deficits may diminish children's preference for self- (vs. other-) owned objects, potentially nullifying the mere ownership effect.

As ownership knowledge is acquired from one's culture via interactions with others (Kanngiesser, Rossano, & Tomasello, 2015; Sparks, Cunningham, & Kritikos, 2016), diagnosis-defining deficits in social-cognition may also hinder developmental understanding of this convention (e.g. Bushwick, 2001). It is well documented that children with ASD experience difficulties interacting with others and show reduced social motivation (APA, 2013; Chevallier, Kohls, Troiani,

Brodkin, & Schultz, 2012). Compared with TD children, those with ASD spend less time engaged in social interactions with peers (Bauminger et al., 2008), are less likely to collaborate (Aldridge et al., 2000; Carpenter et al., 2001; van Ommeren, Begeer, Scheeren, & Koot, 2012), and are less likely to reciprocate in naturalistic interactions (Channon et al., 2001; Hadwin et al., 1997; Wimpory et al., 2007; Joseph & Tager-Flusberg, 2004; Klin et al., 2006; Ozonoff & Miller, 1995). It is also widely acknowledged that children with ASD have fundamental impairments in Theory of Mind (e.g. Baron-Cohen, 1995; Baron-Cohen et al., 1997). As a result of these difficulties, children with ASD may have increased difficulty tracking, and mentally representing, invisible relationships between owners and their property.

To date, a single adult study has investigated the impact of ASD on ownership-related cognition. Grisdale and colleagues (Grisdale et al., 2014) asked adults with autism and neurotypical controls matched on verbal ability, non-verbal functioning, and chronological age to sort pictures into two baskets: one belonging to the participant, and one belonging to experimenter. Participants' memory for the pictures was then tested via a surprise recognition task. While the TD adults demonstrated significantly more accurate recall for pictures belonging to them than the experimenter, adults with ASD recognised self- and other-owned pictures with equivalent accuracy. This suggests that processing objects in relation to the self may not influence cognition in adults with ASD, as it does for TD counterparts. Crucially, however, no prior research has investigated how ASD impacts ownership understanding or related effects in children. Therefore, an important and highly novel goal of this research is to establish whether the influence of ownership on property preferences and valuations is atypical in children with ASD.

For the first time, the present study examined whether children with ASD display mere ownership effects. In Experiment 1 we investigate whether mere ownership influences preferential biases towards objects, plus the ability to track owner-object relationships, via a resource trading paradigm. Children with ASD and TD controls were randomly assigned a gift to keep, before being offered the chance to trade for one of two alternatives (the remaining gifts were taken by the experimenter and a confederate). Over several trials, we recorded how frequently children traded, and how accurately they tracked owner-object relationships. We predicted that mere ownership of gifts

would not confer immaterial value for children with ASD due to impairments encoding information in relation to the self (Lind, 2010). Thus, we expected them to trade significantly more frequently than TD controls, who we expected to show a strong preference for the initially endowed gift (Harbaugh et al., 2001). We also anticipated that impairments in social interaction in ASD (APA, 2013) may reduce children's ability to accurately track owner-object relationships.

In Experiments 2 and 3 we explore how children with ASD and TD controls value self- and other-owned property. In particular, we test whether these populations consider *their* toys to be more desirable than toys belonging to others. We also assess whether children ascribe higher value to their toys than identical copies, and probe their willingness to trade for these copies. Crucially, the results of this study will advance the ownership literature by providing new insight into how fundamental attitudes to property are impacted by ASD (a highly prevalent neurodevelopmental disorder that affects 1 in 100 children; Baird et al., 2006).

2. Experiment 1

2.1. Method

2.1.1. Participants

Participants were 18 children with Autism Spectrum Disorder (16 male; *M* age = 8.9 years, range = 6.1–11.1 years) and 18 TD children (12 male; *M* age = 4.3 years, range = 3–6.1 years) recruited from two specialist schools and one mainstream school in the Cheshire area. Samples were closely matched on receptive vocabulary as measured by the British Picture Vocabulary Scale (BPVS; ASD: *M* age equivalent: 4.82 years, *SD*: 1.6; TD: *M* age equivalent: 4.83 years, *SD*: 1.34; Dunn, Dunn, Whetton & Burley, 1997). All children with ASD were diagnosed by a qualified educational or clinical psychologist, using standardised instruments (i.e. Autism Diagnostic Observation Scale and Autism Diagnostic Interview – Revised; Lord, Rutter, DiLavore & Risi, 2002; Lord, Rutter & Le Couteur, 1994) and expert judgement. Diagnoses were confirmed via the Childhood Autism Rating Scale (CARS; Schopler, Reichler, DeVellis, & Daly, 1980), which was completed by each participant's class teacher (ASD: *M* score = 31.78; TD: *M* score = 15.22). Children with ASD were significantly older ($t(34) = 13.92$, $p < .001$, $d = 4.78$), and had significantly higher CARS scores ($t(34) = 8.28$, $p < .001$, $d = 2.84$) than the TD children. The study was approved by the University Ethics

Committee, and informed consent was obtained from children's caregivers prior to their involvement in the research.

2.1.2. Materials

Stimuli for the trading game included 9 toys divided into 3 sets of 3 based on similarity of size, complexity, and attractiveness (see Figure 1). By including 3 items in a set, the child could not perform at ceiling on the owner identification questions simply by tracking their own object. Each participant was presented with the same sets of toys, which were safe and developmental age-appropriate. In line with previous studies of this nature, children interacted with a puppet during the experimental tasks (e.g. Kanngiesser & Hood, 2014). The inclusion of the puppet as a third party required children to discriminate between two non-owned items when answering owner identification questions in the trading game, reducing the likelihood of correct guessing. Two hand puppets resembling humans were used, one male ("Jack") and one female ("Jill").

Set A: flying frog, bouncy ball, smiley man

Set D: bird whistle, animal rubber, slinky

Set B: paddle bat, Frisbee, recorder

Set E: troll, yoyo, bouncy face

Set C: ball popper, jigsaw puzzle, maze

Set F: xylophone, mini basketball, mini bowling

Fig. 1 Toys used in Experiments 1, 2 and 3; Sets A-C were used in Experiments 1 and 2; Sets D-F were used in Experiment 3

2.1.3. Procedure

Participants were tested individually in their own schools and were accompanied by a familiar adult. Children were verbally praised for attention and good behaviour. Participants completed the BPVS in session one, followed by the trading game in session two on a different day.

Children were introduced to a puppet that matched their gender (Jack or Jill). A set of 3 toys was placed on the table ("Look at these three toys – one, two, three"), and one was allocated to the child ("This toy is yours; this toy is for [child's name]") at random. They were informed that they

could take the toy home and keep it forever. Children were then asked whether they would like to swap their assigned toy for one of the two alternatives ("Would you like to swap your toy for one of these toys? You can swap for another toy if you like. Remember, [child's name] can only keep one toy"). After the child's response, one toy was then taken by the puppet and the other by the experimenter (e.g. "This toy is for Jack, it's his. Jack is going to keep this toy"). All 3 toys were then placed in the middle of the table, away from their corresponding owners, and the child was asked to identify who owned each toy (Ownership Questions; e.g. "Which toy belongs to Jack? Which is his toy?"). The child was allowed to keep their toy. This procedure was repeated over 3 trials, each involving a different set of toys (see Figure 1). We counterbalanced the order that toy sets were presented, which toys in each set were assigned to each party (child, experimenter, puppet), and the order of ownership questions for each trial.

2.2. Results

Every child completed all 3 trials. Participants were assigned a trading score of 0 to 3 corresponding to the number of trials in which they swapped their randomly assigned object for an alternative. An independent samples t-test showed that children with ASD traded their toy significantly more often (74% of trials) than TD children (33% of trials), $t(34) = 4.45$, $p < .001$, $d = 1.53$ (see Figure 2). As there were 3 objects in a set, there was a 1 in 3 chance that children would be randomly assigned the toy they liked most. Thus, there was a 2 in 3 (0.67) chance of trading on any given trial. Over three trials, we would expect children to trade for their favourite toys on 2.01 trials. In comparison with this chance value, TD children traded significantly *less* frequently than expected by chance, $t(17) = -4.72$, $p < .001$, $d = -1.11$, while children with ASD traded at chance, $t(17) = 1.23$, $p = .24$. Importantly, a series of chi-square goodness of fit tests confirmed that there were no preferential trading biases for certain toys in either the ASD group (Set A: $\chi^2 = .33$, $p = .85$; Set B: $\chi^2 = 1.33$, $p = .51$; Set C: $\chi^2 = 1$, $p = .61$) or the TD group (Set A: $\chi^2 = .33$, $p = .85$; Set B: $\chi^2 = 33$, $p = .85$; Set C: $\chi^2 = 3$, $p = .22$). This finding confirms that toys in each set were equally desirable to children in each population.

Participants also scored 0-9 corresponding to the number of ownership questions they answered correctly. An independent samples t-test revealed that children with ASD (93.78% correct)

and TD children (100% correct) did not differ in their ability to track owner-object relationships, $t(34) = -1.43$, $p = .16$ (see Figure 2).

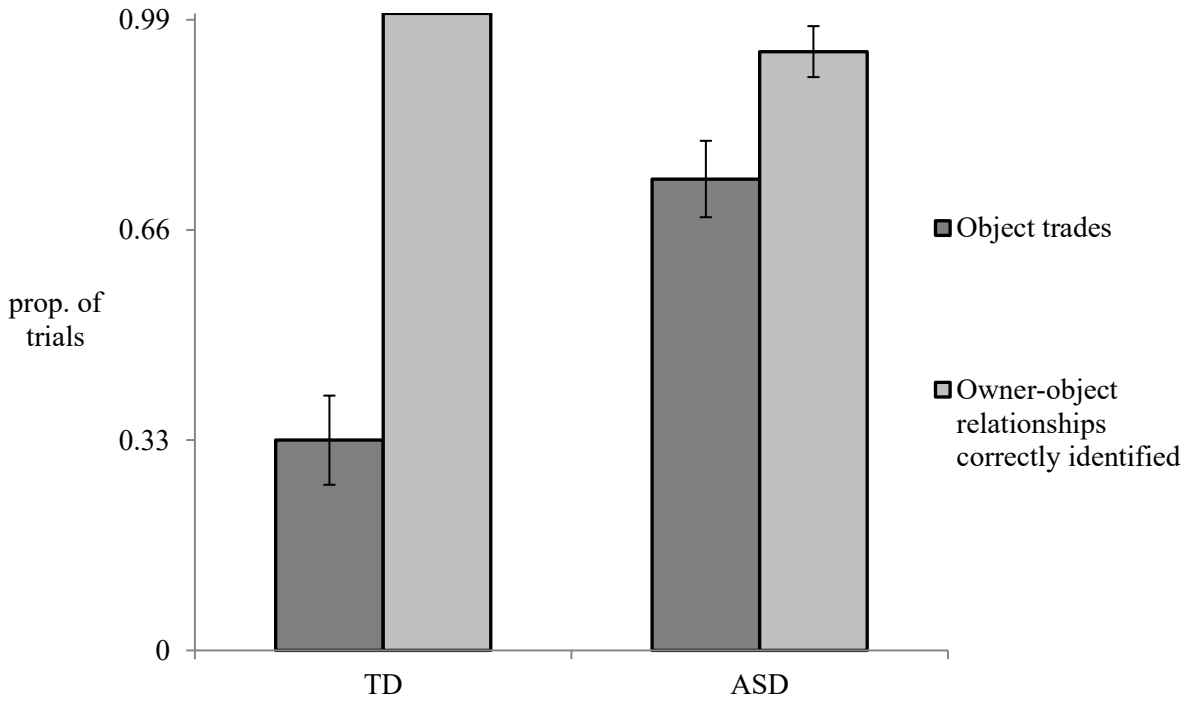

Fig. 2. Proportion of trials in which typically developing (TD) children and children with autism spectrum disorder (ASD) correctly identified owner-object pairings and traded their endowed object. *Note.* Error bars depict SEs.

2.3. Discussion

Experiment 1 investigated whether children with ASD show a preferential bias for objects due to mere ownership and whether they can accurately track owner-object relationships. Strikingly, we reported the very first evidence that children with ASD do *not* show the mere ownership effect whereas TD controls showed a clear preference for a randomly endowed gift. Thus, ownership conferred immaterial value to the endowed object for TD children, but not children with ASD. Both groups were extremely competent at identifying owner-object relationships, indicating a dissociation between owner identification (intact) and over-valuation of self-owned property (absent) in ASD.

Contrary to our predictions, both TD children and children with ASD accurately tracked owner-object relationships. Due to the inclusion of a third party, children could not succeed by simply

attending to their own object (they had to discriminate between objects belonging to the experimenter and the puppet). As owner-object relationships were generated and unambiguously identified for children during the experiment (i.e. children did not need to infer historical ownership via heuristics), accurate recognition of owner-object relationships may have been supported by basic associative learning mechanisms that track statistical relationships between co-occurring stimuli across time and contexts (Plunkett, 1997; Rescorla & Wagner, 1972). As children with ASD are competent associative learners (e.g. Baron-Cohen et al., 1997; Frith & Happé, 1994; Hartley & Allen, 2015; Preissler, 2008; Preissler & Carey, 2005), it is likely that they can effectively track visual co-occurrences between objects and their owners. Nevertheless, it is possible that these children may differ in their sensitivity to more subtle ownership cues that are not possession-based. For example, deficits in social-cognition may reduce children's awareness of gender or age related cues, while impairments in referential language may inhibit the importance of verbal testimony. Difficulties representing the self and others over time and space (Lind, 2010) may also affect children's ability to track owner-object relationships over longer durations.

Excitingly, this experiment shows that mere ownership does not influence object preferences in children with ASD. This theoretically important finding reflects an absence of an extremely robust cultural phenomenon that influences both the psychology of economics and identity. It also aligns with Grisdale et al's (2014) finding that adults with ASD do not show superior memory for self-owned items relative to other-owned items. In accord with previous evidence, the TD controls showed a heightened preference for objects they were randomly endowed with and traded at below-chance rates (also see Beggan, 1992; Gawronski et al., 2007; Harbaugh et al., 2001; Knetsch, 1989; Reb & Connoly, 2007; Thaler, 1980). According to the extended-self hypothesis, this bias results from the endowed object being processed in relation to 'the self', which increases its psychological salience and perceived desirability relative to non-endowed alternatives (Belk, 2000; Csikszentimihalyi & Rochberg-Halton, 1981; Diesendruck & Perez, 2015; Sartre, 1956; Winnicott, 1953). By contrast, fundamental deficits in self-concept development may negate this bias in children with ASD (Bruck et al., 2007; Frith, 2001; Hill et al., 2004; Lind, 2010; Lind & Bowler, 2009). A reduced ability to tag objects as "self-relevant" may result in weakened psychological connections to

self-owned property. Consequently, the children with ASD traded objectively; as all the objects were of equal status, they simply selected the one they liked most.

Although mere ownership did not confer special value to the randomly endowed toys for children with ASD, they might have displayed ownership-related biases for the preferred toys they traded for. As TD individuals, we evaluate ourselves and others based on property, and judge *our* objects to be more desirable, memorable, and valuable than similar objects belonging to others (Cunningham et al., 2013; Gelman et al., 2012; Kahneman et al., 1991). From 3 years of age, TD children consider self-owned objects to be more valuable than identical objects that do not belong to them (Hood & Bloom, 2008; Gelman et al., 2012). Despite there being no aesthetic or functional difference from an identical copy, historical connections to the self resulting from ownership make one's property "authentic" and thus more valuable (Belk, 1985, 1991, 2000; Gelman et al., 2015; James, 1890). In Experiment 2, we explore whether children with ASD display ownership effects when afforded the opportunity to choose their preferred toys.

The objectives of Experiment 2 were to (a) identify whether children with ASD consider their property to be more valuable than comparable property belonging to others, and (b) elucidate whether children with ASD consider their property to be more valuable than identical copies that do not belong to them. Participants were allowed to choose one of three toys (the remaining toys were claimed by the experimenter and a puppet) and then rated the desirability of each toy. Children then rated the desirability of an identical copy of their toy and were offered the opportunity to trade for the copy. As children could claim ownership of the toys they liked most, we predicted that both populations would rate their property as more valuable than property belonging to the puppet and experimenter. However, we expected to observe between-population differences in trading frequencies and ratings for the identical copies. Based on previous evidence (e.g. Hood & Bloom, 2008; Gelman et al., 2012), we suspected that processing the originally selected toy in relation to the self would increase its value for TD children. As the copy had not been intentionally selected, we anticipated that TD children would devalue the copy in relation to the original. This prediction is based on Egan, Santos, and Bloom's (2007) finding that TD 4-year-olds devalue unchosen items in comparison to equally-attractive items they have already chosen. Consequently, we expected that TD

children would trade for the copy very infrequently. By contrast, given the results of Experiment 1, we suspected that children with ASD would regard the copies more favourably and adopt a "why not" attitude to trading. Whilst their originally chosen toy might be preferred over different toys in the set (belonging to the experimenter and puppet), processing in relation to the self may not enhance the value of their already-owned exemplar in comparison to a visually and functionally identical copy that does not belong to them. Crucially, the findings from this experiment will reveal whether children with ASD show reliable preferences for owned items of their choosing, and whether ownership enhances the value of such items over-and-above that of an identical replica.

3. Experiment 2

3.1 Method

3.1.1 Participants

Participants were 18 verbal children with Autism Spectrum Disorder (14 male; *M* age = 8.96 years, range = 6.5–11 years) and 18 TD children (8 male; *M* age = 5.94 years, range = 5.08–6.75 years) recruited from two specialist schools and one mainstream school in the Cheshire area. None of these children participated in Experiment 1. Samples were closely matched on receptive vocabulary as measured by the BPVS (ASD: *M* age equivalent: 6.31 years, *SD*: 1.58; TD: *M* age equivalent: 6.24 years, *SD*: 0.63; Dunn et al., 1997). All children with ASD were diagnosed by a qualified educational or clinical psychologist, using standardised instruments (i.e. Autism Diagnostic Observation Scale and Autism Diagnostic Interview – Revised; Lord et al., 2002; Lord et al., 1994) and expert judgement. Diagnoses were confirmed via the CARS (Schopler et al., 1980), which was completed by each participant's class teacher (ASD: *M* score = 33.58; TD: *M* score = 15.28). Children with ASD were significantly older ($t(34) = 9.6$, $p < .001$, $d = 3.2$), and had significantly higher CARS scores ($t(34) = 8.89$, $p < .001$, $d = 2.96$) than the TD children. The groups did not differ on receptive vocabulary, $t(34) = 0.16$, $p = .87$. The study was approved by the University Ethics Committee, and informed consent was obtained from children's caregivers prior to their involvement in the research.

3.1.2. Materials

Stimuli for the valuation game included the same 9 toys as in Experiment 1, again divided into 3 sets of 3 based on monetary value, similarity of size, complexity, and attractiveness (see Figure

1). Each participant was presented with the same sets of toys. Stimuli for the warm-up task included six objects of varying value and attractiveness (toy dinosaur, toy car, pen, ruler, crumpled piece of paper, toilet roll tube). As in Experiment 1, participants interacted with one of two hand puppets that resembled humans ("Jack" and "Jill"). Children's preferences/valuations were indicated via three laminated pictures depicting 5 stars, 3 stars, and 1 star respectively.

3.1.3. Procedure

Participants were tested individually in their own schools and were accompanied by a familiar adult. Children were verbally praised for attention and good behaviour. Participants completed the BPVS in session one, followed by the valuation game in session two on a different day.

3.1.3.1. Warm-up game. The experimenter presented and verbally labelled three objects – one of high desirability (e.g. a realistic toy dinosaur), one of average desirability (e.g. a pen), and one of low desirability (e.g. a crumpled piece of paper). The experimenter then presented three laminated cards depicting five gold stars, three gold stars, and one gold star respectively ("Here I have 1 star, here I have 3 stars, and here I have 5 stars"). They then explained how the star cards represented the desirability of the three objects, and assigned them accordingly ("I'm going to give the toy dinosaur 5 stars because it's the very best. I'm going to give the pen 3 stars because it's okay. I'm going to give the paper 1 star because it's the worst"). The experimenter then removed these objects and presented and named a new set of three objects that varied in desirability (e.g. a toy car, a colourful ruler, and a toilet roll tube). Children were then asked to use the star cards to indicate the desirability of each object ("Here you have 1 star, here you have 3 stars, and here you have 5 stars. How many stars for the toy car? How many stars for the ruler? How many stars for the toilet roll tube?"). As young children do not reliably understand monetary value (Berti & Bombi, 1981), we adopted Bloom et al.'s (2016) strategy of using desirability ratings as a proxy for financial valuations. We inferred that children understood the rating system if they allocated 5 stars for the car, 3 stars for the ruler, and 1 star for the toilet roll. If children responded differently, they were provided with corrective feedback and asked to try again (e.g. "Actually, I think this one is much better than this one, this should get a 5…").

3.1.3.2. Valuation game. Participants were introduced to a puppet that matched the child's gender (Jack or Jill). Children were informed that they would play a game and that they would receive some toys ("Now we're going to look at some toys, and at the end you can keep some of them!"). A set of 3 toys was placed on the table and children were instructed to select one to keep ("Look at these three toys – one, two, three. You can choose one of these toys to keep. Which toy would [child's name] like to take home to keep? [after child's selection] Here, this toy is yours, this toy is for [child's name]". The chosen toy was then moved in front of the participant. After the child's response, one toy was then taken by the puppet and the other by the experimenter (e.g. "Sophie is going to keep this toy, it's hers. And Jack/Jill is going to keep this toy, it's his/hers"), and these toys were moved in front of their respective owners. Children were then asked to indicate the desirability of each toy using the star cards ("Here you have 1 star, here you have 3 stars, and here you have 5 stars. How many stars for [child's] toy? How many stars for Sophie's toy? How many stars for Jack/Jill's toy?"). No feedback was provided by the experimenter. After indicating a star card for each toy, children were presented with an identical copy of the toy that they chose to keep ("Wow, look at this! It's just like your toy!"). Children were asked to indicate the value of the copy ("How many stars for this toy?") and offered the chance to swap their current toy for it ("Would you like to swap your toy for this toy? Remember, you can only keep one of these toys"). The child was then allowed to keep the final toy in their possession. This procedure was repeated over 3 trials, each involving a different set of toys (see Figure 1). We counterbalanced the order that toy sets were presented, the order in which children were asked to rate the three objects in each set, and randomised which toys in each set were selected by the puppet and experimenter.

3.2. Results

Every child completed all 3 trials. Participants' desirability ratings (1, 3, 5) for each toy were recorded, and they were assigned a trading score of 0-3 corresponding to the number of trials in which they swapped their toy for an identical copy. Every child successfully completed the warm-up task on their first attempt, with the exception of one child with ASD who required two attempts.

Children's average desirability ratings were entered into a 2(Population: ASD, TD) x 3(Owner: child, experimenter, puppet) mixed ANOVA (see Figure 3), which revealed a significant

main effect of Owner, $F(2, 68) = 37.69$, MSE = 0.78, $p < .001$, $\eta_p^2 = .53$. Bonferroni-adjusted pairwise comparisons showed that children in both populations assigned significantly higher desirability ratings to their toys ($M = 4.7$) than toys belonging to the experimenter ($M = 3.33$) or puppet ($M = 3$), which did not differ. There was no effect of Population and no interaction. An independent samples t-test showed that children with ASD swapped their toy for an identical copy significantly more often (67% of trials) than TD children (22% of trials), $t(34) = 3.69$, $p < .001$, $d = 1.23$ (see Figure 4). Children's desirability ratings for the toys they chose were compared against the ratings for the identical copies via a 2(Population: ASD, TD) x 2(Item: child's toy, identical copy) mixed ANOVA. Significant main effects of Population, $F(1, 34) = 36.5$, MSE = 0.55, $p < .001$, $\eta_p^2 = .52$, and Item, $F(1, 34) = 52.22$, MSE = 0.33, $p < .001$, $\eta_p^2 = .61$, were qualified by a significant Population x Item interaction, $F(1, 34) = 52.16$, MSE = 0.33, $p < .001$, $\eta_p^2 = .61$, which was explored via a series of Bonferroni-adjusted pairwise comparisons. While TD children assigned significantly higher desirability ratings to their toys ($M = 4.67$) than the identical copies ($M = 2.7$), $t(17) = 8.06$, $p < .001$, $d = 2.1$, children with ASD almost always rated their toys ($M = 4.74$) and the identical copies ($M = 4.74$) exactly the same ($t = 0.01$, $p = .99$). TD children and children with ASD rated their toys very similarly ($t = .45$, $p = .66$), but the identical copy ratings of children with ASD were significantly higher than those of TD children, $t(34) = 7.66$, $p < .001$, $d = 2.56$.

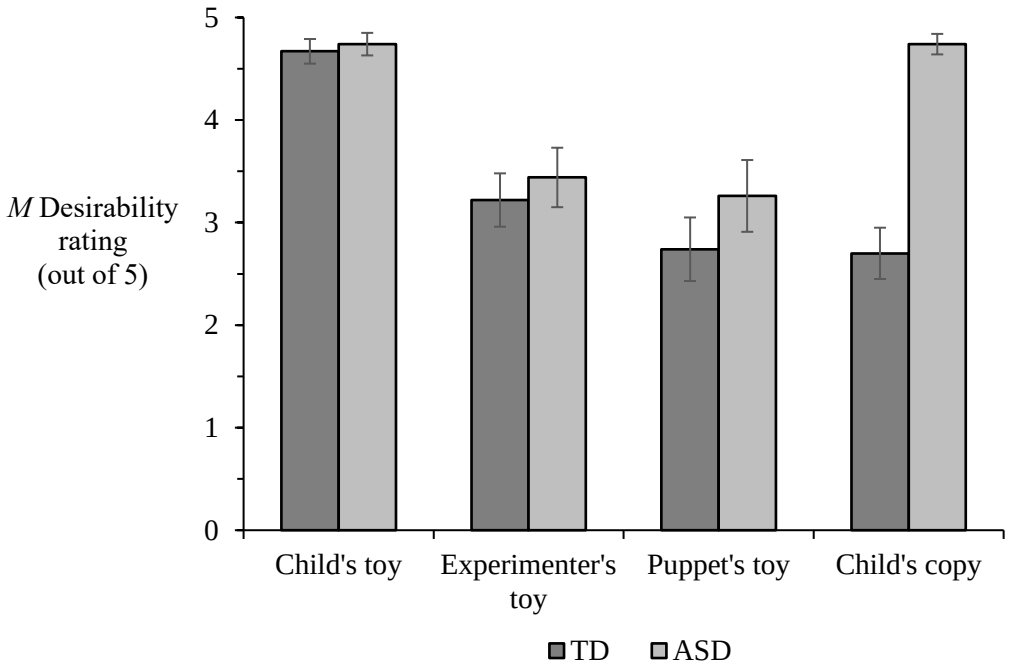

Fig. 3. Mean desirability ratings for each item type by children with autism spectrum disorder (ASD) and typically developing (TD) children in Experiment 2. *Note.* Error bars depict SEs.

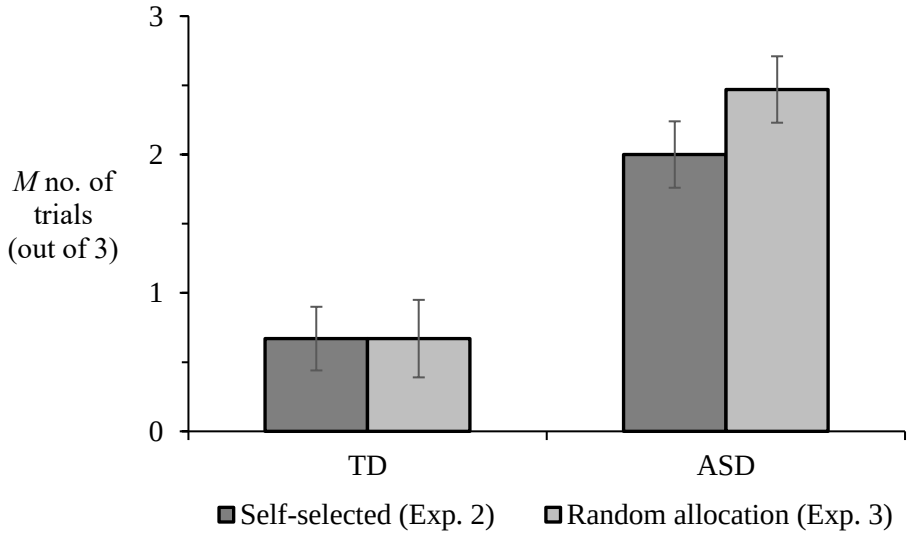

Fig. 4. Mean number of trials in which typically developing (TD) children and children with autism spectrum disorder (ASD) traded their already-owned toy for an identical copy in Experiments 2 and 3. *Note.* Error bars depict SEs.

A series of chi-square goodness of fit tests confirmed that there were no preferential selection biases for certain toys in either the ASD group (Set A: $\chi^2 = 4$, $p = .14$; Set B: $\chi^2 = 0.33$, $p = .85$; Set C: $\chi^2 = 0.33$, $p = .85$) or the TD group (Set A: $\chi^2 = 1$, $p = .61$; Set B: $\chi^2 = 0.33$, $p = .85$; Set C: $\chi^2 = 0.33$, $p = .85$). Furthermore, the average desirability ratings for individual objects did not significantly differ within each set (Set A: $F = .07$, $p = .94$; Set B: $F = 1.55$, $p = .22$; Set C: $F = .82$, $p = .09$). These findings confirm that toys in each set were equally desirable to children in each population.

3.3. Discussion

Experiment 2 investigated whether children with ASD and TD children regard self-owned toys as more valuable than comparable and identical toys they do not own. As anticipated, both populations regarded their chosen toys as significantly more valuable than different toys belonging to other owners. Also in line with our predictions, TD children rated their already-owned toys as significantly more valuable than the non-owned copies, while children with ASD rated the copies just as highly as their original toys. In addition, children with ASD swapped their original toy for an identical copy significantly more frequently than TD children. These findings advance theoretical understanding of ownership by revealing similarities and differences in how TD children and children with ASD evaluate property. Children with ASD prefer self-owned items if they are self-selected *and* different from other-owned items (like TD controls), but ownership does not add inherent value to their property over-and-above a non-owned copy (unlike for TD controls).

Although both the TD and ASD groups regarded self-owned toys more favourably than other-owned toys, their contrasting attitudes towards the identical copies suggest that this preference may be driven by different factors. As in Hood and Bloom (2008) and Gelman et al. (2012), the TD children considered identical copies to be significantly less valuable than toys they owned. The selection process at the start of each trial likely strengthened the child's connection to their chosen toy, conferring "authentic" status. Establishing ownership also caused the original toy to be processed in relation to the self, triggering the extension of self-related cognitive biases to the toy (Beggan, 1992; Kim & Johnson, 2012, 2015). Hood and colleagues (2016) propose that because children tend to view themselves favourably, ownership may result in the transfer of positive self-perceptions to the toy, resulting in increased valuation. Indeed, the extent to which TD children and adults over-value their

property increases when they are primed to focus on the self rather than others (Hood et al., 2016). By comparison, the identical copy lacked any prior connection to the child and may have been devalued because it was not intentionally chosen. Despite the copy being visually and functionally identical to the child's toy, thus making it objectively equivalent in attractiveness and desirability, TD children may have assigned lower value ratings to resolve cognitive dissonance caused by their bias towards their already-owned possession (Egan et al., 2007). Alternatively, TD children may have devalued the copy to appear consistent in their beliefs. Having just rated their toy as more valuable than the experimenter's and puppet's toys, TD children might have devalued the copy to uphold their favourable attitude towards their new property. Overall, our findings for the TD group support the theory that ownership adds value to a unique exemplar, making it stand apart from other items of the same type.

In stark contrast, children with ASD considered the identical copy to be just as valuable as the toy they owned. This finding aligns with the results from Experiment 1 where mere ownership did not bias children with ASD to prefer a randomly endowed toy. Rather, they consistently traded for the toy they liked most. Here, children chose their preferred toy at the outset of each trial and, accordingly, considered it to be more valuable than non-preferred alternatives. However, ownership of that toy did not make it any more valuable than another exemplar with no connection to the self. That is, children with ASD regarded identical items to be of very similar value, irrespective of differences in ownership. This pattern of responding suggests that property evaluations by children with ASD may be increasingly objective, focusing on physical and instrumental qualities as opposed to abstract connections to the self or others (e.g. my toy car is exactly the same as Matt's toy car; I like them both equally because they do not differ in appearance or functionality). These results also provide novel evidence that children with ASD do not automatically devalue non-selected items in comparison to chosen items of equal desirability (indicating the absence of a mechanism that has been observed across cultures, ages, and species; Egan et al., 2007). It may be that deficits in social-cognition and mental state reasoning cause children with ASD to be relatively unconcerned about presenting consistent attitudes to others (e.g. Baron-Cohen, 1995), therefore reducing their motivation to uphold the belief that their original toy is the most valuable.

Based on the current data, it is impossible to discriminate whether TD children's heightened valuation of self-owned property was elicited by mere ownership or preferences for individual toys. Allowing them to choose a toy from a set resulted in them consistently owning the item they liked most (blending the two influences). Therefore, the objective of Experiment 3 was to elucidate whether ownership reliably increases children's valuations of self-owned items, regardless of preferences for specific toys. We employed the same paradigm as in Experiment 2, with one crucial exception: the child's toy was allocated at random. As in Experiment 1, there was a 1 in 3 chance of children receiving the toy they liked the most. Consequently, if valuation ratings are based on preferences for individual toys, there should be no differences between average valuation ratings for each owner (i.e. across children and trials, favourite toys would be allocated to the child, puppet, and experimenter on 33% of trials respectively). If, however, mere ownership influences children's preferences – irrespective of what the toy is – we should observe differences in valuation ratings for self- and other-owned property.

Based on previous evidence (e.g. Gelman et al., 2012), plus the results of Experiments 1 and 2, we predicted that mere ownership would bias TD children to assign higher valuations to their randomly endowed toys than comparable toys belonging to others. We also expected them to under-value identical copies and trade infrequently. On the other hand, we anticipated that the valuation ratings of children with ASD would be more objective, assigning the highest ratings to toys they like most irrespective of ownership. Importantly, observing these between-population differences would both confirm that mere ownership irrationally biases the preferences of TD children and support our theory that children with ASD are significantly less susceptible to mere ownership effects.

4. Experiment 3

4.1. Method

4.1.1. Participants

Participants were 15 verbal children with ASD (12 male; *M* age = 8.97 years, range = 6.5–11 years) and 15 TD controls (7 male; *M* age = 5.86 years, range = 5.08–6.75 years) that all participated

in Experiment 2.[1] Samples were closely matched on receptive vocabulary as measured by the BPVS (ASD: *M* age equivalent: 6.3 years, *SD*: 1.49; TD: *M* age equivalent: 6.21 years, *SD*: 0.59; Dunn et al., 1997). Children with ASD were significantly older ($t(28) = 8.6$, $p < .001$, $d = 3.14$), and had significantly higher CARS scores ($t(28) = 7.41$, $p < .001$, $d = 2.71$) than the TD children (ASD: *M* CARS score = 33.17; TD: *M* CARS score = 15.33). The groups did not differ on receptive vocabulary, $t(28) = 0.22$, $p = .83$. The study was approved by the University Ethics Committee, and informed consent was obtained from children's caregivers prior to their involvement in the research.

4.1.2. Materials

Stimuli included a different set of 9 toys divided into 3 sets of 3 based on monetary value, similarity of size, complexity, and attractiveness (see Figure 1), 6 warm-up objects of varying value and attractiveness (teddy bear, toy truck, notebook, rubber, paperclip, bottle lid), two human-looking hand puppets, and three laminated cards depicting 5 stars, 3 stars, and 1 star.

4.1.3. Procedure

The warm-up task was exactly as described in Experiment 1 (using different objects). The valuation game was also identical except for how toys were assigned to participants. Rather than allowing children to choose which toy they would like to keep, they were instead allocated a toy by the experimenter ("Look at these three toys – one, two, three. This toy is yours, this toy is for [child's name]. [child's name] can take this toy home to keep, it's yours."). This toy was then moved in front of the participant. The experimenter and puppet then each claimed a toy, and these were moved in front of their respective owners. Children then indicated the desirability of the three objects using the star cards as described above. Children were then presented with an identical copy of their toy, which they were asked to value. They were also offered the chance to trade their already-owned toy for the copy. This procedure was repeated over 3 trials, each involving a different set of toys (see Figure 1). We counterbalanced the order that toy sets were presented, which toy in each set was allocated to the participant, which toys in each set were selected by the experimenter and puppet, and the order in which children were asked to rate the three objects in each set.

[1] Three children with ASD who participated in Experiment 2 were unavailable to participate in Experiment 3. To balance the sample sizes, three TD children with the most similar BPVS scores were also excluded.

4.2. Results

Every child completed all 3 trials. As in Experiment 2, participants' desirability ratings (1, 3, 5) for each toy were recorded, and they were assigned a trading score of 0-3 corresponding to the number of trials in which they swapped their toy for an identical copy. Every child successfully completed the warm-up task on their first attempt.

Children's average desirability ratings were entered into a 2(Population: ASD, TD) x 3(Owner: child, experimenter, puppet) mixed ANOVA (see Figure 5). The results revealed a significant main effect of Owner, $F(2, 56) = 16.13$, MSE = 0.8, $p < .001$, $\eta_p^2 = .37$, which was qualified by a significant Population x Owner interaction, $F(2, 56) = 6.09$, MSE = 0.8, $p = .004$, $\eta_p^2 = .18$. This interaction was investigated via a series of Bonferroni-adjusted pairwise comparisons. The desirability ratings of children with ASD and TD children did not statistically differ for their randomly allocated toys (ASD *M*: 4.11; TD *M*: 4.56; $t = 1.8$, $p = .08$) or the experimenter's toys (ASD *M*: 3.27; TD *M*: 3.44; $t = 0.41$, $p = .68$). However, children with ASD assigned significantly higher ratings to the puppet's toys than TD children (ASD *M*: 3.62; TD *M*: 2.56; $t(28) = 2.41$, $p = .023$, $d = 0.88$). For children with ASD, there were no statistically significant differences between desirability ratings for toys belonging to them, the experimenter, or the puppet ($p = .18$-$.54$). By contrast, TD children assigned significantly higher ratings to their toy than the experimenter's toy ($p = .012$) and the puppet's toy ($p < .001$). Irrespective of ownership status, the average desirability ratings for individual toys did not significantly differ within each set (Set D: $F = 1.87$, $p = .16$; Set E: $F = 2.67$, *p*

= .09; Set F: $F = 0.29$, $p = .75$).

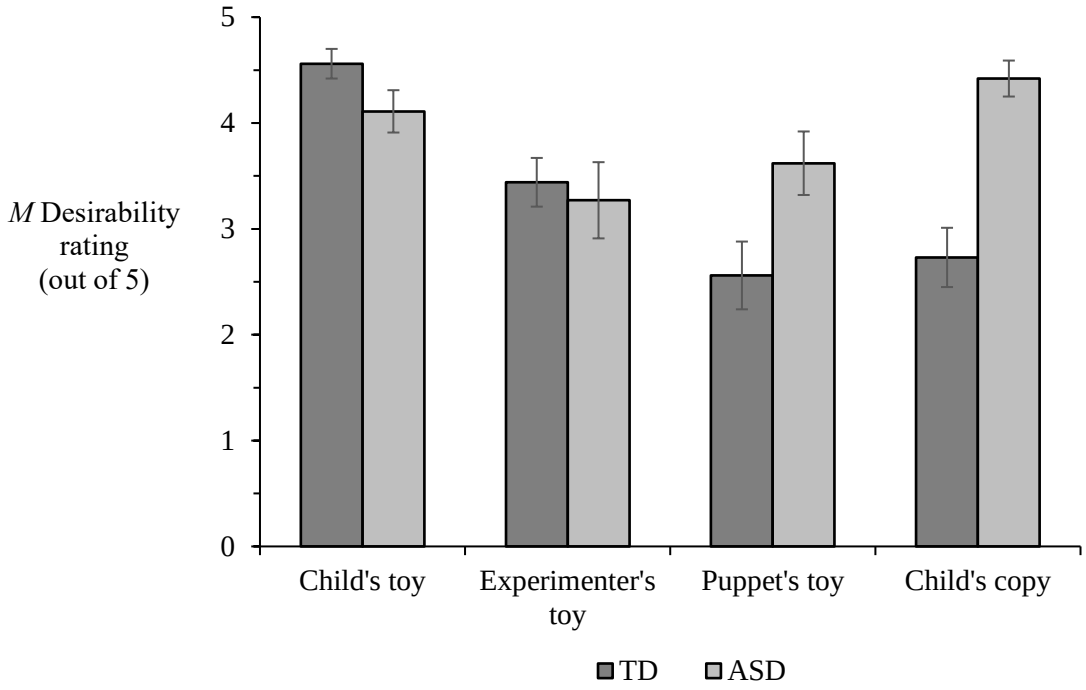

Fig. 5. Mean desirability ratings for each item type by children with autism spectrum disorder (ASD) and typically developing (TD) children in Experiment 3. *Note.* Error bars depict SEs.

As in Experiment 2, an independent samples t-test showed that children with ASD swapped their toy for an identical copy significantly more often (82% of trials) than TD children (23% of trials), $t(28) = 5.43$, $p < .001$, $d = 1.98$ (see Figure 4). Children's desirability ratings for their randomly allocated toys were compared against the ratings for the identical copies via a 2(Population: ASD, TD) x 2(Item: child's toy, identical copy) mixed ANOVA. Significant main effects of Population, $F(1, 28) = 7.26$, MSE = 0.8, $p = .012$, $\eta_p^2 = .21$, and Item, $F(1, 28) = 18.38$, MSE = 0.47, $p < .001$, $\eta_p^2 = .4$, were qualified by a significant Population x Item interaction, $F(1, 28) = 36.66$, MSE = 0.47, $p < .001$, $\eta_p^2 = .57$, which was assessed via a series of Bonferroni-adjusted pairwise comparisons. Children with ASD again rated their toys ($M = 4.11$) and the identical copies ($M = 4.42$) similarly ($t = 1.53$, $p = .15$), whereas TD children assigned significantly higher ratings to their toys ($M = 4.56$) than the identical copies ($M = 2.73$), $t(14) = 6.34$, $p < .001$, $d = 1.79$. Children with ASD rated

the identical copies significantly more favourably than TD children, $t(28) = 5.13$, $p < .001$, $d = 1.88$, but ratings for their toys did not statistically differ ($t = 1.8$, $p = .08$).

4.3. Discussion

Informed by our previous results, Experiment 3 tested whether mere ownership causes TD children and children with ASD to over-value random toys relative to non-owned toys (that were potentially preferred) and identical copies. As in Experiment 2, TD children assigned significantly higher ratings to self-owned toys than other-owned toys and identical copies (which were rarely traded for). For children with ASD, there were no statistically significant differences between valuations across the three owners. Thus, mere ownership did *not* reliably increase the value of their randomly endowed property. We again observed that children with ASD were keen to swap for identical copies which were regarded to be of similar value to their already-owned toys. Alongside Experiments 1 and 2, these findings show that mere ownership reliably influences the property valuations of TD children, but not children with ASD.

Despite there being a 67% probability of *not* receiving their favoured toy in a set, TD children consistently rated their randomly allocated toys as the most valuable. This striking behaviour supports the theory that mere ownership can elicit favourable biases towards certain objects, even overriding initial preferences for other items. The fact that identical non-owned copies were regarded as significantly less valuable than already-owned toys again shows that children's heightened preferences were restricted to their unique exemplars, and did not extend to object categories (see Gelman et al., 2012). Viewed beside the results of Experiments 1 and 2, these findings suggest that TD children's preferences and valuations for property are more strongly influenced by abstract ownership connections to people than material qualities (e.g. an object's appearance and function). This illustrates just how powerful an influence ownership has on the psychology of young children in Western cultures.

By contrast, ownership appears to have little influence on how children with ASD evaluate property. For these children, merely owning an object does not necessarily make it more valuable than other objects, or identical copies, belonging to others. Rather, the preferences and valuations of children with ASD appear to be dependent on what a toy *is*, rather than whom it belongs to. Hence, it

would seem that the judgements of children with ASD are actually more rational in economic terms than those of TD individuals. These results strongly support our hypothesis that ASD impacts fundamental cognitive mechanisms that cause ownership to have such a significant influence on our individual and social psychological existence.

5. General Discussion

This study was the first to investigate whether children with ASD prefer and over-value property due to mere ownership. Our findings across three experiments reveal that, for children with ASD, ownership alone does *not* elicit heightened valuation and preferences for one's own property. In Experiment 1, we discovered that children with ASD did not reliably favour a randomly endowed toy and frequently traded for a different object that they preferred. By contrast, TD children showed a clear preference for their randomly endowed toy and traded infrequently. Both populations also demonstrated highly-accurate tracking of owner-object relationships. Experiment 2 showed that both TD children and children with ASD over-value their toys if they are self-selected and different from other-owned toys. However, unlike TD children, children with ASD did not over-value their toys in comparison to non-owned identical copies. This finding was replicated in Experiment 3, which also established that mere ownership was sufficient to elicit over-valuation of randomly endowed property (in comparison to other-owned property) in TD children. However, children with ASD did not consistently regard their randomly endowed toys as the most valuable, and evaluated property irrespective of ownership. Taken together, these results strongly indicate that ASD may suppress one of the most powerful and reliable phenomena in psychology and economics (Loewenstein & Issacharoff, 1994).

In Western cultures, there is a strong connection between ownership and personal identity; we evaluate ourselves and others based on property (Belk, 1985, 1991, 2000; Cunningham et al., 2013; James, 1890; Kahneman et al., 1991). A vast literature spanning psychology, philosophy, and economics argues that ownership is so influential because we assimilate property into our extended self-concept – who we *are* is affected by what we *own* (Belk, 1988; Csikszentimihalyi & Rochberg-Halton, 1981; Diesendruck & Perez, 2015; Sartre, 1956). Establishing ownership forges a mentalisic connection between the self and a property item, transforming the item into a physical marker of our

personal identity (Belk, 1988; Sartre, 1956). Consequently, self-related cognitive biases are transferred to our property, causing us to perceive self-owned items to be of higher value and desirability than other items, including identical exemplars, which do not belong to us (Diesendruck & Perez, 2015; Hood et al., 2016). The responses of our TD participants across all three experiments strongly align with this theoretical perspective, and support prior evidence that children reliably, and sometimes irrationally, over-value objects merely due to ownership-induced connections to the self (Hood & Bloom, 2008; Hood et al., 2016; Gelman et al., 2012). Furthermore, the TD children's ratings for identical copies replicate prior evidence for devaluation of objects that have *not* been intentionally chosen in comparison to those that have (Egan et al., 2007). In our experiments, this mechanism may serve to resolve cognitive dissonance caused by children's bias towards one exemplar in a pair of identical objects (with objectively equal desirability), or to maintain consistency in their belief that their property is the most valuable.

Conversely, mere ownership does not elicit irrational biases in children with ASD. This population only displayed reliable preferences for self-owned property that they *chose*, and thus subjectively preferred, in comparison to different alternatives. The fact that children with ASD ascribed very similar values to identical copies of these items confirms that ownership does not confer special value to a particular exemplar. This behaviour also indicates that, unlike TD children, children with ASD do not automatically devalue non-selected items in comparison to chosen items of equal desirability (Egan et al., 2007). We argue that profound deficits in self-understanding and self-concept development may diminish the advantageous effects of ownership in children with ASD (Frith, 2003; Grisdale et al., 2012; Lind, 2010). If one's psychological sense of self is impaired, or their extended self-concept is under-developed, it follows that processing external objects in relation to the self would have little bearing on their perceived value. Consequently, children with ASD seem relatively unconcerned with who an item belongs to when communicating preferences and valuations. Rather, their judgements may be driven primarily by what an object is and does. This suggests that ownership understanding in ASD is incongruent with the essentialist view that an item's value can be radically influenced by "invisible" qualities connected to its history (see Bloom & Gelman, 2008). For example, collectors of celebrity memorabilia are willing to pay extraordinary amounts for mundane

items that were owned or used by famous individuals (e.g. a lock of pop singer Justin Bieber's hair sold for $40,668 on EBay in 2011; BBC, 2011). It would be interesting to investigate whether individuals with ASD experience a desire to own "authentic" items of this nature. Furthermore, additional research is required to identify specific historical and material factors that reliably influence property valuations of children with ASD.

An alternative possibility is that the absence of ownership effects in the ASD group was related to diagnosis-defining deficits in social interaction (APA, 2013). It has been argued that ownership effects are associated with the importance of individualism, consumerism, and materialism at a cultural level (Bauer, Wilkie, Kim, & Bodenhausen., 2012; Gao, Wheeler, & Shiv, 2009; Morrison & Johnson, 2011; Newman et al., 2011). Thus, it may be that impairments in social-cognition and social motivation inhibit children with ASD (APA, 2013; Chevallier et al., 2012) from acquiring these values through engagement with their culture. As a result, the cognitive influence of ownership on Western children with ASD may resemble that observed in non-Western TD cultures that prioritise collectivist values (Gjersoe, Newman, Chituc, & Hood, 2014; Sparks et al., 2016). Gjersoe et al. (2014) report that Indian adults consider objects associated with famous individuals to be less valuable than American adults (but do not differ when valuing objects based on material properties), while Sparks et al. (2016) found that ownership does not influence recognition memory in Asian adults. However, this theory is weakened by recent evidence that Western TD children aged 2-4 years display ownership effects despite being too young to recognise or understand materialistic values (Hood et al., 2016; Gelman et al., 2012). This evidence suggests that lack of cultural knowledge or awareness cannot sufficiently explain the absence of ownership effects in Western children with ASD. Nevertheless, social deficits in ASD may impact ownership understanding in other ways. Although our ASD group demonstrated highly-accurate tracking of owner-object relationships in Experiment 1, correct responding could have been underpinned by sensitivity to possession-based statistics. We recommend that future research explore whether children with ASD differ in their awareness and use of ownership heuristics that are not based on observing possession, particularly social-cultural stereotypes relating to age and gender.

Of course, we must address the limitations of this study. It is possible that the observed between-group differences are an effect of limited cognitive abilities rather than autism per se. We acknowledge that including a sample of children with major learning difficulties matched to children with ASD on non-verbal intelligence would have eliminated this issue. As we propose that differences in responding between children with ASD and TD children are linked to differences in self-understanding, this study would have benefited from a specific measure of this ability. Despite the fact that the varied deficits in self-understanding in ASD are robust and well-documented (see Lind, 2010), our theoretical explanations require validation in future research. Finally, it is important to clarify an aspect of our argument. We acknowledge that children with ASD do form strong attachments to certain possessions (particularly if those objects are involved in stereotypic routines), however, our evidence suggests that mere ownership does not confer privileged status to new possessions (as it does for TD children and adults).

6. Conclusions

Our study was the first to explore whether children with ASD display mere ownership effects. Our results advance the ownership literature by demonstrating that children with ASD do not prefer or over-value property due to mere ownership. We propose that deficits in self-understanding may diminish ownership effects in ASD, eliciting a more economically-rational perspective that prioritises material qualities (e.g. what a toy *is*) rather than whom it belongs to. By contrast, our TD participants preferred and over-valued random objects due to ownership. These findings support prior evidence by indicating that favourable biases are conferred to one's own property due to processing items in relation to the self. Overall, this study has provided novel insight into how children's thinking and behaviour towards self-owned property is influenced by ASD and highlights important directions for future research.

Compliance with Ethical Standards

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from parents/caregivers prior to children's participation in this study.

Acknowledgements

We would like to thank the children, parents and staff at Lisburne School (UK), the Together Trust (UK), Rosebank School (UK), and Mellor Primary School (UK).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Aldridge, M. A., Stone, K. R., Sweeney, M. H., & Bower, T. G. R. (2000). Preverbal children with autism understand the intentions of others. *Developmental Science, 3*, 294–301. doi:https://doi.org/10.1111/1467-7687.00123

American Psychiatric Association (APA, 2013). *Diagnostic and statistical manual of mental health disorders (5th ed)*. Washington DC: Author.

Argo, J. J., Dahl, W. D., & Morales, A. C. (2008). Positive consumer contagion: Responses to attractive others in retail contexts. Journal of Marketing Research, 45, 690–701.doi:101509/ jmkr.45.6.690.

Baird, G., Simonoff, E., Pickles, A., Chandler, S., Loucas, T., Meldrum, D., &, Charman, T. (2006). Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: the Special Needs and Autism Project (SNAP). *Lancet, 368*, 210–215. doi:10.1016/S0140-6736(06)69041-7.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Cambridge, MA: MIT Press.

Baron-Cohen, S., Baldwin, D. A., & Crowson, M. (1997). Do children with autism use the speaker's direction of gaze strategy to crack the code of language? *Child Development, 68*, 48–57. doi:10.2307/1131924.

Bauer, M. A., Wilkie, E. B., Kim, J. K., & Bodenhausen, G. V. (2012). Cuing consumerism: Situational materialism undermines personal and social well-being. *Psychological Science, 23*, 517–523. doi:http://dx.doi.org/10.1177/0956797611429579.

Bauminger, N., Solomon, M., Aviezer, A., Heung, K., Gazit, L., Brown, J., & Rogers, S. J. (2008). Children with autism and their friends: A multidimensional study of friendship in high-functioning autism spectrum disorder. *Journal of abnormal child psychology*, *36*(2), 135-150. doi:https://doi.org/10.1007/s10802-007-9156-x

Beggan, J. (1992). On the social nature of nonsocial perception: The mere ownership effect. Journal of Personality and Social Psychology, 62, 229–237. doi:10.1037/0022-3514.62.2.229

Belk, R. W. (1985). Materialism: Trait aspects of living in the material world. *Journal of Consumer Research, 12*, 265–280.

Belk, R. W. (1988). Possessions and the extended self. *Journal of Consumer Research, 15*, 139–168.

Belk, R. W. (1991). Possessions and the Sense of Past. In R. W. Belk. (Ed.), *Highways and buyways: Naturalistic research from the consumer behavior odyssey* (pp. 114-130). Provo, UT: Association for Consumer Research.

Belk, R. W. (2000). Are we what we own? In: Benson, A. (Ed.), *I shop therefore I am: Compulsive buying and the search for self* (pp. 76-104). London/New York: Jason Aronson.

Ben Shalom, D., Mostofsky, S. H., Hazlett, R. L., Goldberg, M. C., Landa, R. J., Faran, Y. et al. (2006). Normal physiological emotions but differences in expression of conscious feelings in children with high-functioning autism. *Journal of Autism and Developmental Disorders, 36,* 395–400. doi:10.1007/s10803-006-0077-2.

Berti, A. E., & Bombi, A. S. (1981). The development of the concept of money and its value: A longitudinal study. *Child Development, 52*, 1179–1182.

Bloom, P., & Gelman, S. A. (2008). Psychological essentialism in selecting the 14th Dalai Lama. *Trends in Cognitive Sciences, 12*, 243. doi:10.1016/j.tics.2008.04.004

British Broadcasting Corporation. (BBC, 2011). *Justin Bieber's hair makes £25,000 in eBay charity sale*. Retrieved from http://www.bbc.co.uk/newsbeat/article/12645673/justin-biebers-hair-makes-25000-in-ebay-charity-sale

Brown, D.E. (1991). *Human universals*. New York, NY: McGraw-Hill.

Bruck, M., London, K., Landa, R., & Goodman, J. (2007). Autobiographical memory and suggestibility in children with autism spectrum disorder. *Development and Psychopathology, 19,* 73-95. doi:10.1017/S0954579407070058.

Bushwick, N. L. (2001). Social learning and the etiology of autism. *New Ideas in Psychology*, *19*(1), 49-75. doi:10.1016/S0732-118X(00)00016-7.

Carpenter, M., Pennington, B. F., & Rogers, S. J. (2001). Understanding of others' intentions in children with autism. *Journal of Autism and Developmental Disorders, 31*, 589–599.

Channon, S., Charman, T., Heap, J., Crawford, S., & Rios, P. (2001). Real-life-type problem-solving in Asperger's syndrome. *Journal of Autism and Developmental Disorders, 31*, 461–469. doi:https://doi.org/10.1097/00146965-200303000-00002

Chevallier, C., Kohls, G., Troiani, V., Brodkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in Cognitive Science, 16*, 231–239. doi:https://doi.org/10.1016/j.tics.2012.02.007.

Csikszentimihalyi, M., & Rochberg-Halton, E. (1981). *The meaning of things: Domestic symbols and the self*. Cambridge, MA: Cambridge University Press.

Cunningham, S. J., Vergunst, F., Macrae, C. N., & Turk, D. J. (2013). Exploring early self-referential memory effects through ownership. *British Journal of Developmental Psychology*, *31*, 289-301.doi:10.1111/bjdp.12005.

Diesendruck, G., & Perez, R. (2015). Toys are me: Children's extension of self to objects. *Cognition, 134*, 11-20. doi:10.1016/j.cognition.2014.09.010.

Dittmar, H. (1992). *The social psychology of material possessions: To have is to be*. Hemel Hempstead, UK/New York: Harvester Wheatsheaf/St. Martin's Press

Dunn, L. M., Dunn, L. M., Whetton, C., & Burley, J. (1997). *The British Picture Vocabulary Scale – Second Edition.* Windsor: NFER-Nelson.

Egan, L. C., Santos, L. R., & Bloom, P. (2007). The origins of cognitive dissonance: Evidence from children and monkeys. *Psychological science*, *18*, 978–983. doi:http://dx.doi.org/10.1111/j.1467-9280.2007.02012.x.

Fasig, L. G. (2000). Toddlers' understanding of ownership: Implications for self-concept development. *Social Development, 9*, 370–382. doi:10.1111/1467-9507.00131

Friedman, O., Van de Vondervoort, J.W., Defeyter, M.A., & Neary, K.R. (2013). First possession, history, and young children's ownership judgements. *Child Development, 84*, 1519-1525. doi:10.1111/cdev.12080.

Frith, U. (2001). Mind blindness and the brain in autism. *Neuron*, *32*, 969-979. doi:10.1016/S0896-6273(01)00552-9.

Frith, U. (2003). *Autism: Explaining the enigma*. Massachusetts: Blackwell Publishing.

Frith, U., & Happé, F. (1994). Language and communication in autistic disorders. *Philosophical Transactions of the Royal Society London B, 346,* 97–104. doi:10.1098/rstb.1994.0133.

Gao, L., Wheeler, S. C., & Shiv, B. (2009). The 'shaken self': Product choices as a means of restoring self-view confidence. *Journal of Consumer Research, 36,* 29–38. doi:http://dx.doi.org/10.1086/596028.

Gawronski, B., Bodenhausen, G., & Becker, A. (2007). I like it, because I like myself: Associative self-anchoring and post-decisional change of implicit evaluations. *Journal of Experimental Social Psychology, 43,* 221–232. doi:10.1016/j.jesp.2006.04.001.

Gelman, S. A., Frazier, B. N., Noles, N. S., Manczak, E. M., & Stilwell, S. M. (2015). How much are Harry Potter's glasses worth? Children's monetary evaluation of authentic objects. *Journal of Cognition and Development*, *16*, 97-117. doi:http://dx.doi.org/10.1080/15248372.2013.815623.

Gelman, S. A., Manczak, E. M., & Noles, N. S. (2012). The nonobvious basis of ownership: Preschool children trace the history and value of owned objects. *Child Development, 83,* 1732-1747. doi:10.1111/j.1467-8624.2012.01806.x.

Gjersoe, N. L., Newman, G. E., Chituc, V., & Hood, B. (2014). Individualism and the extended-self: Cross-cultural differences in the valuation of authentic objects. *PLoS One, 9.* http://dx.doi.org/10.1371/ journal.pone.0090787.

Goddard, L., Howlin, P., Dritschel, B., & Patel, T. (2007). Autobiographical memory and social problem-solving in Asperger syndrome. *Journal of Autism and Developmental Disorders, 37,* 291-300. doi:10.1007/s10803-006-0168-0.

Grisdale, E., Lind, S. E., Eacott, M. J., & Williams, D. M. (2014). Self-referential memory in autism spectrum disorder and typical development: Exploring the ownership effect. *Consciousness and Cognition, 30,* 133–141. doi: 10.1016/j.concog.2014.08.023.

Hadwin, J., Baron-Cohen, S., Howlin, P., & Hill, K. (1997). Does teaching a theory of mind have an effect on social communication in children with autism. *Journal of Autism and Developmental Disorders, 27,* 519–537.

Harbaugh, W. T., Krause, K., & Vesterlund, L. (2001). Are adults better behaved than children? Age, experience, and the endowment effect. *Economic Letters, 70*, 175–181. doi:10.1016/S0165-1765(00)00359-1.

Hartley, C., & Allen, M. (2015). Symbolic understanding of pictures in low-functioning children with autism: The effects of iconicity and naming. *Journal of Autism and Developmental Disorders, 45*, 15–30. doi:10.1007/s10803-013-2007-4.

Hay, D., & Ross, H. (1982). The social nature of early conflict. *Child Development, 53*, 105–111. doi:10.2307/1129642.

Hill, E., Berthoz, S., & Frith, U. (2004). Brief report: Cognitive processing of own emotions in individuals with autistic spectrum disorder and in their relatives. *Journal of autism and developmental disorders, 34*, 229-235. doi:10.1023/B:JADD.0000022613.41399.14.

Hood, B. M., & Bloom, P. (2008). Children prefer certain individuals over perfect duplicates. *Cognition, 106*, 455–462.

Hood, B., Weltzien, S., Marsh, L., & Kanngiesser, P. (2016). Picture yourself: Self-focus and the endowment effect in preschool children. *Cognition, 152*, 70–77. doi:10.1016/j.cognition.2016.03.019.

Humphrey, N. (1992). *A history of the mind: Evolution and the birth of consciousness.* New York, NY: Simon & Schuster.

James, W. (1890). *The principles of psychology*. New York, NY: Holt.

Jordan, R. R. (1996). Pronouns and autism. *International Journal of Psychology, 31*, 169-172.

Joseph, R. M., & Tager-Flusberg, H. (2004). The relationship of theory of mind and executive functions to symptom type and severity in children with autism. *Development and Psychopathology, 16*, 137–155. doi:https://doi.org/10.1017/s095457940404444x

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1990). Experimental tests of the endowment effect and the Coase Theorem. *Journal of Political Economy, 98*, 1325–1348. doi:10.1086/261737.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *The Journal of Economic Perspectives, 5 (1)*, 193–206. doi:http://dx.doi.org/10.2307/1942711.

Kalish, C. W., & Anderson, C. D. (2011). Ownership as a social status. In O. Friedman & H. Ross (Eds.), *Children's ownership* (pp. 65–77). San Francisco: New Directions in Child and Adolescent Development.

Kanngiesser, P., & Hood, B. (2014). Young children's understanding of ownership rights for newly made objects. *Cognitive Development, 29*, 30-40. doi:10.1016/j.cogdev.2013.09.003.

Kanngiesser, P., Rossano, F., & Tomasello, M. (2015). Late emergence of the first possession heuristic: Evidence from a small-scale culture. *Child Development, 86*, 1282-1289. doi:10.1111/cdev.12365.

Kim, K., & Johnson, M. K. (2012). Extended self: Medial prefrontal activity during transient association of self and objects. *Social Cognitive and Affective Neuroscience, 7(2),* 199–207. doi:http://dx.doi.org/10.1093/scan/nsq096.

Kim, K., & Johnson, M. K. (2014). Extended self: Spontaneous activation of medial prefrontal cortex by objects that are 'mine'. *Social Cognitive and Affective Neuroscience, 9(7),* 1006–1012. doi:http://dx.doi.org/10.1093/scan/nst082.

Klin, A., Saulnier, C., Sparrow, S., Cicchetti, D. V., Volkmar, F., & Lord, C. (2006). Social and communication abilities and disabilities in higher functioning individuals with autism spectrum disorders: The vineland and the ADOS. *Journal of Autism and Developmental Disorders, 37*, 788–793. doi:https://doi.org/10.1007/s10803-006-0229-4.

Knetsch, J. L. (1989). The endowment effect and evidence of nonreversible indifference curves. *American Economic Review, 79*, 1277–1284.

Lee, A., Hobson, R. P., & Chiat, S. (1994). I, you, me, and autism: An experimental study. *Journal of Autism and Developmental Disorders, 24*, 155-176. doi:10.1007/BF02172094.

Lind, S. E. & Bowler, D. M. (2009). Recognition memory, self-other source memory, and theory-of-mind in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 39,* 1231–1239. doi:10.1007/s10803-009-0735-2.

Lind, S. E. (2010). Memory and the self in autism: A review and theoretical framework. *Autism, 14*, 430-456. doi:10.1177/1362361309358700.

Loewenstein, G., & Issacharoff, S. (1994). Source dependence in the valuation of objects. *Journal of Behavioral Decision Making, 7*, 157–168. doi: http://dx.doi.org/10.1002/bdm.3960070302

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview – Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24 (5)*, 659–685. doi:10.1007/BF02172145.

Lord, C., Rutter, M., DiLavore, P. C., & Risi, S. (2002). *Autism Diagnostic Observation Schedule (WPS edition)*. Los Angeles: Western Psychological Services.

Morewedge, C. K., & Giblin, C. E. (2015). Explanations of the endowment effect: An integrative review. *Trends in Cognitive Science, 19*, 229–348.

Morrison, K. R., & Johnson, C. S. (2011). When what you have is who you are: Self-uncertainty leads individualists to see themselves in their possessions. *Personality and Social Psychology Bulletin, 37*, 639–651. doi:http://dx.doi.org/10.1177/0146167211403158.

Nancekivell, S. E., Van de Vondervoort, J. W., & Friedman, O. (2013). Young children's understanding of ownership. *Child Development Perspectives, 7*, 243–247. doi:10.1111/cdep.12049.

Newman, G. E., Diesendruck, G., & Bloom, P. (2011). Celebrity contagion and the value of objects. *Journal of Consumer Research, 38(2)*, 215–228. doi:http://www.jstor.org/stable/10.1086/658999.

Ozonoff, S., & Miller, J. N. (1995). Teaching theory of mind: A new approach to social skills training for individuals with autism. *Journal of Autism and Developmental Disorders, 25*, 415–433. doi:https://doi.org/10.1007/bf02179376

Plunkett, K. (1997). Theories of early word learning. *Trends in Cognitive Sciences, 1*, 146 – 153.

Preissler, M. A. (2008). Associative learning of pictures and words by low-functioning children with autism. *Autism, 12(3)*, 229–246. doi: 10.1177/1362361307088753.

Preissler, M. A., & Carey, S. (2005). What is the role of intentional inference in word learning? Evidence from autism. *Cognition, 97*, B13–23. doi:10.1016/j.cognition.2005.01.008.

Reb, J., & Connolly, T. (2007). Possession, feelings of ownership and the endowment effect. *Judgment and Decision Making, 2*, 107–114.

Rescorla, R., & Wagner, A. (1972). A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. In Black, A. & Prokasy, W. (Eds.), *Classical conditioning II: Current research and theory* (pp. 64–99). New York: Appleton-Century-Crofts.

Rochat, P. (2010). The innate sense of the body develops to become a public affair by 2–3 years. *Neuropsychologia, 48*, 738–745. doi:10.1016/j.neuropsychologia.2009.11.021.

Sartre, J. P. (1956). *Being and nothingness*. New York: Washington Square Press.

Saylor, M. M., Ganea, P. A., & Vasquez, M. D. (2011). What's mine is mine: Twelve month-olds use possessive pronouns to identify referents. *Developmental Science, 14*, 859–864. doi:10.1111/j.1467-7687.2010.01034.x.

Schopler, E., Reichler, R., DeVellis, R., & Daly, K. (1980). Toward objective classification of childhood autism: Childhood autism rating scale (CARS). *Journal of Autism and Developmental Disorders, 10*, 91–103. doi:10.1007/BF02408436.

Silani, G., Bird, G., Brindley, R., Singer, T., Frith, C., & Frith, U. (2008). Levels of emotional awareness and autism: An fMRI study. *Social Neuroscience, 3*, 97–112. doi:10.1080/17470910701577020.

Sparks, S., Cunningham, S. J., & Kritikos, A. (2016). Culture modulates implicit ownership-induced self-bias in memory. *Cognition, 153*, 89–98. doi:10.1016/j.cognition.2016.05.003.

Thaler, R. (1980). Towards a positive theory of consumer choice. *Journal of Economic Behavior and Organization, 1*, 39–60. doi:10.1016/0167-2681(80)90051-7.

Uddin, L. Q. (2011). The self in autism: An emerging view from neuroimaging. *Neurocase*, *17*(3), 201–208. doi:http://dx.doi.org/10.1080/13554794.2010.509320

van Ommeren, T. B., Begeer, S., Scheeren, A. M., & Koot, H. M. (2012). Measuring reciprocity in high functioning children and adolescents with autism spectrum disorders. *Journal of autism and developmental disorders, 42(6),* 1001-1010. doi:https://doi.org/10.1007/s10803-011-1331-9

Williams, D. (2010). Theory of own mind in autism: Evidence of a specific deficit in self-awareness? *Autism, 14*(5), 474–494. doi:http://dx.doi.org/10.1177/1362361310366314

Williams, D.M. & Happé, F. (2010). Representing intentions in self and other: Studies of autism and typical development. *Developmental Science, 13,* 307-319. doi:10.1111/j.1467-7687.2009.00885.x.

Wimpory, D., Hobson, R., & Nash, S. (2007). What facilitates social engagement in preschool children with autism? *Journal of Autism and Developmental Disorders, 37*, 564–573. doi:https://doi.org/10.1007/s10803-006-0187-x

Winnicott, D. W. (1953). Transitional objects and transitional phenomena: A study of the first not-me possession. *International Journal of Psychoanalysis, 32*, 374–392.

Winnicott, D. W. (1969). The child, the family, and the outside world. Baltimore: Penguin.